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Publisher *Taylor & Francis*

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Separation & Purification Reviews

Publication details, including instructions for authors and subscription information:

<http://www.informaworld.com/smpp/title~content=t713597294>

A review of: "Membrane Separation Processes P. Meares, Ed. Elsevier Scientific Publishing Co, Amsterdam, New York, 1976; hardbound, 600 pages, \$ 101.95"

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To cite this Article von Oss, Carel J.(1978) 'A review of: "Membrane Separation Processes P. Meares, Ed. Elsevier Scientific Publishing Co, Amsterdam, New York, 1976; hardbound, 600 pages, \$ 101.95"', *Separation & Purification Reviews*, 7: 1, 135 — 137

To link to this Article: DOI: 10.1080/03602547808066057

URL: <http://dx.doi.org/10.1080/03602547808066057>

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BOOK REVIEW

MEMBRANE SEPARATION PROCESSES

P. Meares, Ed.

Elsevier Scientific Publishing Co., Amsterdam,
New York, 1976; hardbound, 600 pages, \$ 101.95

This multi-authored book treats the state of the art of the principal membrane separation processes in fourteen chapters: 1) The physical chemistry of transport and separation by membranes, by P. Meares; 2) Liquid permeation through polymeric membranes, by H.D. Spriggs; 3) Principles and practice of ultrafiltration, by W.F. Blatt; 4) Reverse osmosis (hyperfiltration) in water desalination, by F.L. Harris, G.B. Humphreys and K.S. Spiegler; 5) Hollow fibres in reverse osmosis, dialysis, and ultrafiltration, by B. Baum, W. Holley, and R.A. White; 6) Electrodialysis, by G.S. Solt; 7) Piezodialysis, by F.B. Leitz; 8) The separation of gases by selective permeation, by S.A. Stern; 9) Hydrocarbon separation by liquid membrane processes, by R.P. Cahn and N.N. Li; 10) Enzyme membranes, by D. Thomas and S.R. Caplan; 11) Separators and membranes in electrochemical power sources, by J.A. Lee, W.C. Maskell and F.L. Tye; 12) Recent developments in ion-selective membrane electrodes, by R. Bloch and E. Löbel; 13) The treatment of aqueous wastes and foods by membrane processes, by D.C. Sammon; and 14) Biomedical applications of membrane processes, by C.R. Gardner.

Chapter 1 is an excellent and thorough combination of a theoretical introduction and a summary, and chapter 2 gives a further theoretical basis of liquid permeation through polymeric membranes. Chapter 3 comprises a rather uneven treatment of ultrafiltration, largely based on the experience with the systems of one Corporation.

This chapter shares with many others a weakness in (or even a total ignorance of) the historical background of the field. The author states that early membranes were unsuccessful because they were "amorphous" (meaning homogeneous or isotropic). This is simply not so: most early membranes were anisotropic, but that fact was not known, with disastrous results. Loeb's and Sourirajan's merit lay in their discovery of the existence of membrane anisotropy, and in their further development of extremely useful anisotropic structures. It is a misconception to attribute, as a property of certain membranes, the lack of a sharp transition point between particulate and macromolecular retention. This is linked, on the contrary, to the nature of these "particles" and/or "molecules": in the size range of 100-1,000Å it simply ceases to be fruitful to discuss them in terms of "dissolved molecules" or "suspended particles". Early work on binding measurements by ultrafiltration is not mentioned, nor is work that includes treatment of binding measurements of solutes that are not (as is so often the case) passed 100% through the membrane. The methodology and characteristics of the systems made by the author's employers are treated extensively, (without however divulging the procedure of membrane preparation), but no mention is made, and no references or recipes are given on the preparation, composition and properties of other membranes of various pore sizes. Chapter 4 extensively discusses reverse osmosis. Chapter 5 gives a thorough treatment of the uses and the composition and preparation of hollow fibres. Chapter 6 deals, fairly briefly, with ion exchange membranes and electrodialysis. In chapter 7 the interesting and possibly quite promising novel concept of piezodialysis is described. Chapter 8 deals with the separation of gases. Chapter 9 is an excellent presentation of hydrocarbon separation by liquid membrane processes. In chapter 10 enzyme membranes are discussed. Chapter 11, on separators and membranes in batteries, deals with membranes as separators, a subject which, although not usually treated under Separation Science, nevertheless fits in quite well here. Chapter 13 describes recent developments in ion-selective membrane electrodes, which ho-

ever does not include anything more recent than 1973. Chapter 13 deals with treatment methods of aqueous wastes and foods involving membranes; particularly in whey treatment the background given is exceedingly slight: several decennia of research and development in this field, in Europe as well as in this country, are entirely ignored. The last chapter, 14, on biomedical applications of membrane processes, is excellent: it may be well the best chapter of the entire work. (Although it may be stretching the field of applications of membranes in Separation Science somewhat, to include contact lenses).

In conclusion, this work treats many aspects of membrane separation processes very well indeed. The historical background is not this work's strongest point. The book must have undergone considerable delays before it became printed, as there are few literature quotation more recent than 1973, so that in some ways it is not terribly up to date. The references are not only somewhat dated, they are also put together according to various different systems (sequentially, alphabetically, etc.). The book is otherwise well-edited and well-printed, although the price seems, even nowadays, on the exorbitant side, for American standards. However, the work is highly recommended to all those who are interested in separation science, and it is indeed indispensable to all workers involved in membrane separation processes.

Carel J. van Oss